P Quantities and units in mechanics

P1

Understand and use fundamental quantities and units in the SI system: length, time, mass.

Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.

Assessed at AS and A-level

Teaching guidance

Students should:

- know and be able to use the following:

Fundamental quantity	**SI base unit**
length	metre (m)
time	second (s)
mass	kilogram (kg)

P Quantities and units in mechanics

P1

Understand and use fundamental quantities and units in the SI system: length, time, mass.

Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.

- be able to convert between commonly used SI units, for example kilometres and metres or kilograms and tonnes
- know and be able to use the following:

Derived quantity	**SI unit**
velocity	metre per second (m s^{-1})
acceleration	metre per second squared (m s^{-2})
force/weight	newton (N)
moment	newton metre (Nm) [**A-level only**]

- understand that understand that weight is a force, $W = mg$ (N)

P Quantities and units in mechanics

P1

Understand and use fundamental quantities and units in the SI system: length, time, mass.

Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.

- if required, be able to convert non-standard units into standard units, for example kilometres per hour to metres per second
- be familiar with equivalent notations such as m/s^2 and $m\ s^{-2}$
- know that trigonometric ratios and the coefficient of friction do not have units
- know that g is acceleration due to gravity ($m\ s^{-2}$) and in questions where a value of g is given, the final answer should be given to the same degree of accuracy as the value of g
- know that all other values used in Mechanics questions are treated as exact values.

7.1 Standard Units & Basic Dimensions

When answering questions in Mechanics, you will be expected to give answers with units.

Often you will lose marks if you do not do this!

7.1 Standard Units & Basic Dimensions

The **International System of Units** (S.I.) was developed so that measurements could be consistent around the world.

These units include the **metre** (length), the **kilogram** (mass) and the **second** (time).

These are referred to as **base units** which means they can be used to derive

7.1 Standard Units & Basic Dimensions

Other units, such as **velocity** and **acceleration**, are called **derived units** because they are combinations of the base units.

All quantities can be measured in units derived from the base S.I. units.

7.1 Standard Units & Basic Dimensions

Kinematics is the study of motion.

It uses distance, displacement, speed, velocity and time.

These are derived from the fundamental quantities of mass, length and time.

7.1 Standard Units & Basic Dimensions

ample 1: Complete the table

Vector	Scalar	Fundamental Quantities*	SI Units
Displacement			
Velocity			
Acceleration			

undamental quantities are: mass, length and time

7.1 Standard Units & Basic Dimensions

ample 1: Complete the table

Vector	Scalar	Fundamental Quantities*	SI Units
Displacement	Distance	Length	Metres ()
Velocity	Speed		Metres per second ()
Acceleration		=	Metres per second squared ()

undamental quantities are: mass, length and time

7.1 Standard Units & Basic Dimensions

Statics & Dynamics are the studies of forces in equilibrium and the forces causing motion respectively.

These involve the derived quantities of **force** and **weight**.

Force = mass x acceleration

In terms of base units, this is kg x ms^{-2} = $kgms^{-2}$

Or – Newtons!

7.1 Standard Units & Basic Dimensions

Weight is the force of gravity on an object.

An object with mass kg has weight N, where is the acceleration due to gravity:

On Earth, this is 9.81 ms^{-2} to 3sf.

On the Moon, your mass would be the same, but your weight would be different!

Weight is a vector quantity whereas mass

7.1 Standard Units & Basic Dimensions

When doing calculations in mechanics, you must check that all the same units are used throughout the question.

This may involve converting units before doing a calculation in order for a formula to work.

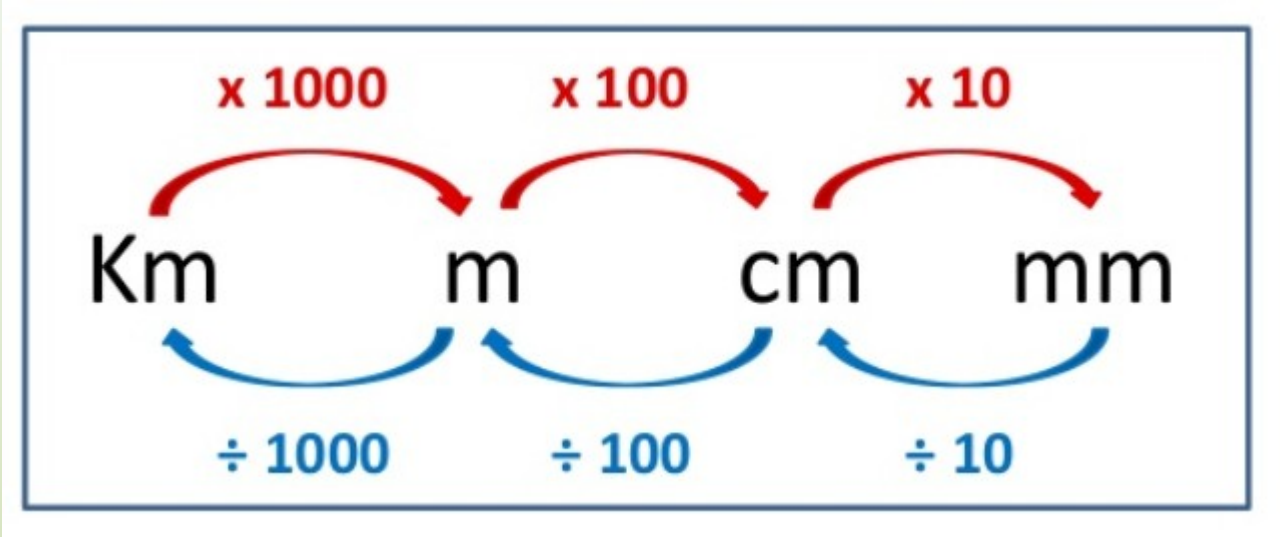
When doing calculations involving , this will usually be given as 9.81, 9.8 or 10. Your answers should be given to the same degree of accuracy as

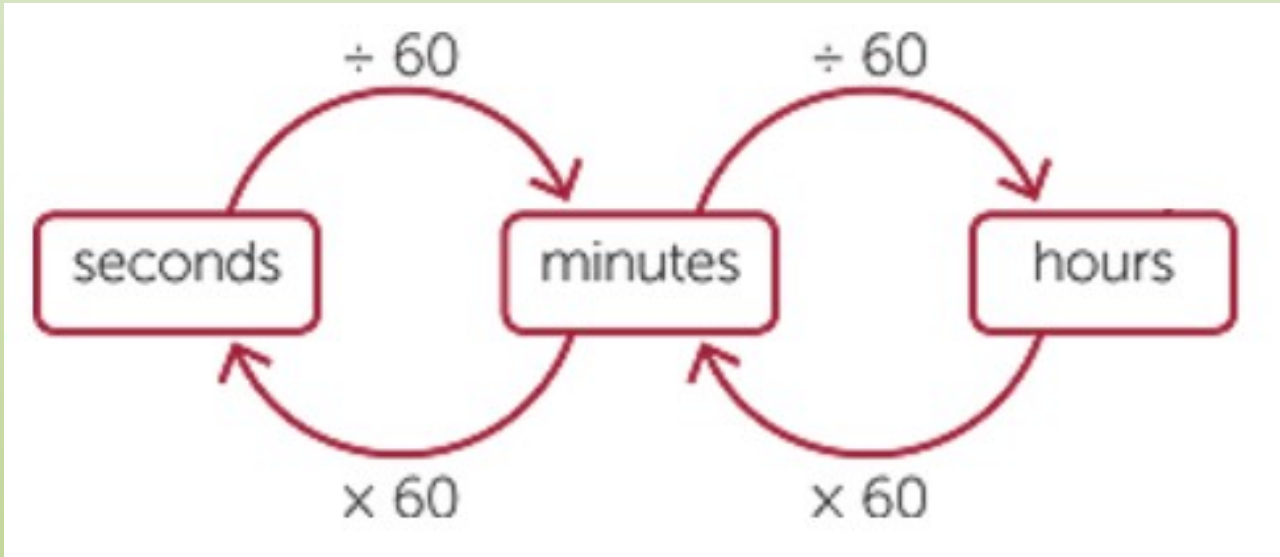
7.1 Standard Units & Basic Dimensions

Remember:

to change larger units to smaller units, multiply

to change smaller units to





7.1 Standard Units & Basic Dimensions

Example 2a

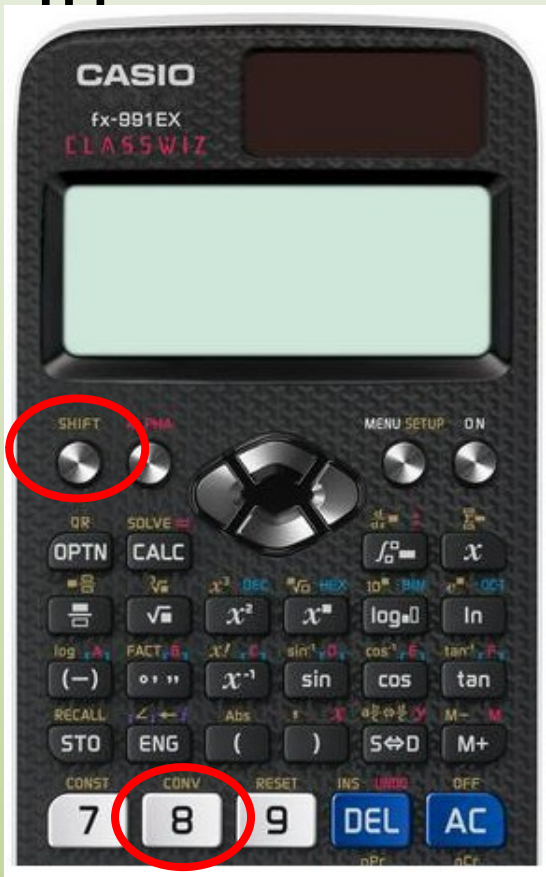
a) Express a velocity of 72 kmh^{-1} in ms^{-1}

7.1 Standard Units & Basic Dimensions

Example 2b

b) Express a velocity of 30 ms^{-1} in kmh^{-1}

Your calculator will do this for you!!... Type 30, then shift, CONV, scroll down to 1:Velocity, select m/s > km/h, press =

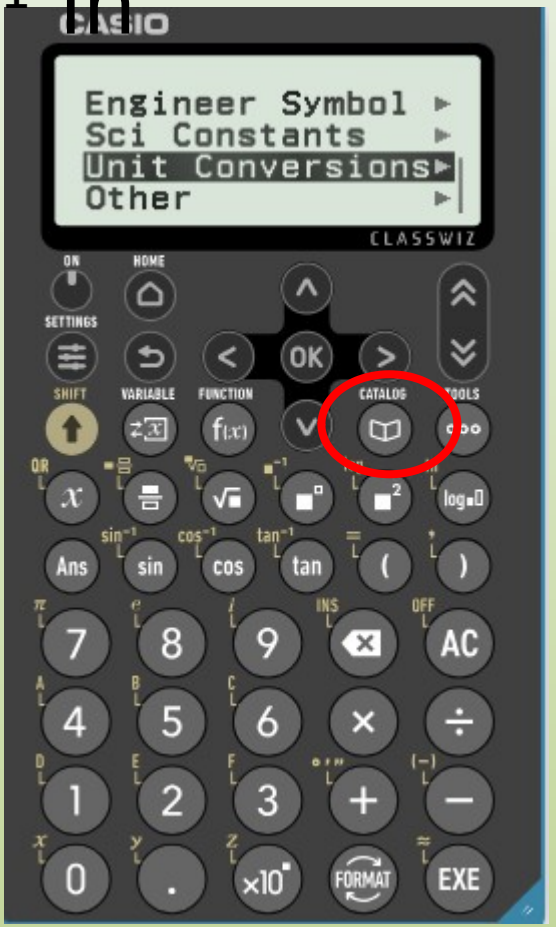


7.1 Standard Units & Basic Dimensions

Example 2b

b) Express a velocity of 30 ms^{-1} in kmh^{-1}

Type 30 then press catalog, select unit conversions, then velocity, select m/s > km/h then press EXE



7.1 Standard Units & Basic Dimensions

Example 2c

c) Express an acceleration of 360 kmh^{-2} in ms^{-2}

Your calculator will NOT convert this for you!

7.1 Standard Units & Basic Dimensions

Example 3

Given that and are velocities, is acceleration and is displacement; use the formula to work out if km/h, km/h and m/s^2. Give your answer in km.

Convert to consistent units first (calc where possible):

7.1 Standard Units & Basic Dimensions

Example 3

Ex 7.1A&B